

## ORGANISMS CAUSING DETRIMENTAL ROOT GALLS

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Certain organisms are capable of modifying the physiology of root cells and causing swellings or overgrowths known as galls. In North America there are well over 2000 different organisms known to produce galls on aboveground plant parts or on the roots of plants (5). Worldwide, approximately 40% of the root gall-inducing organisms are nematodes, and approximately an equal number are bacteria (3). In addition, certain viruses, actinomycetes, fungi, algae, and insects are capable of inducing root galls. Many gall-forming organisms, for example, *Rhizobium* spp. on legumes, are beneficial to their hosts. The scope of this circular is limited to organisms causing detrimental root galls.

**NEMATODES:** Root-knot nematodes, *Meloidogyne* spp. are known to cause galls on roots of more than 2000 plant species (1). Infected roots swell at the point of invasion and may develop galls which are two or three times larger in diameter than the healthy roots. If multiple infections occur on the same root, the galls may coalesce, and give the root a club-like appearance (Fig. 1A). Worldwide, this gall-forming group of nematodes represents one of the major pests which limit food production. In addition to root-knot nematodes, sheath nematodes, *Hemicycliophora* spp., false root-knot nematodes, *Nacobbus* sp., dagger nematodes, *Xiphinema* spp., and needle nematodes, *Longidorus* spp., may cause small galls or swellings on the roots of certain plants.

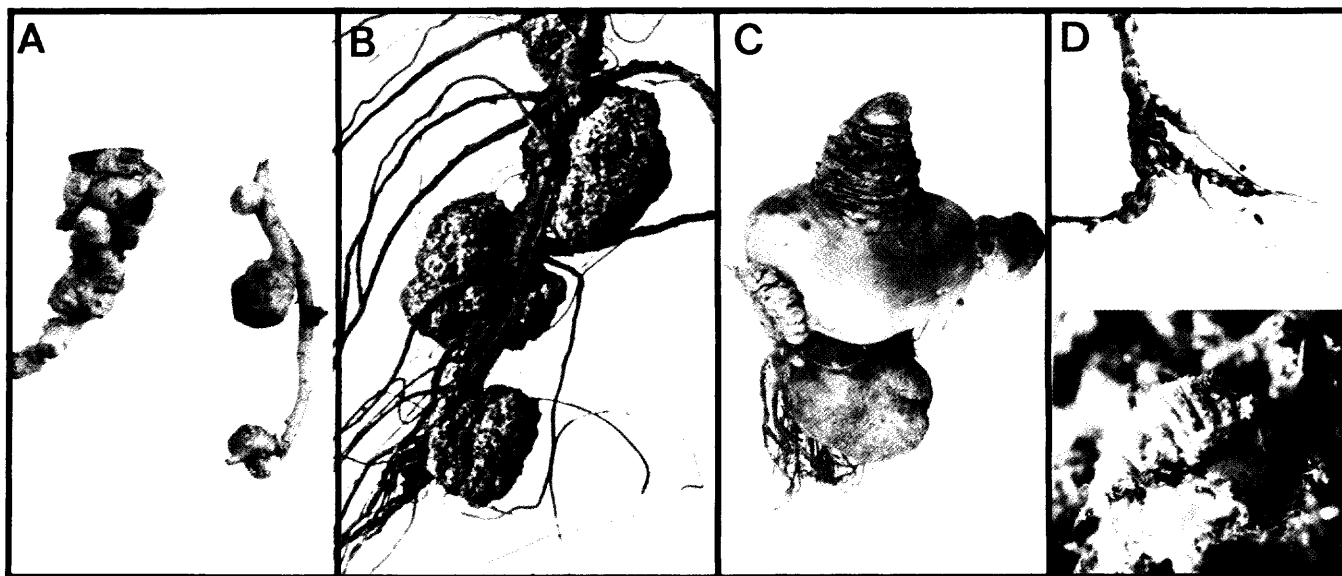


Fig. 1. Detrimental galls caused by different types of organisms. A: Galls on *Carica papaya* (papaya) roots caused by a mixed population of *Meloidogyne javanica* and *M. incognita*; B: Galls on *Carya illinoensis* (pecan) roots caused by *Agrobacterium tumefaciens*; C: Roots of *Brassica napobrassica* (rutabaga) with galls caused by *Plasmodiophora brassicae*; D: Roots of *Malus* sp. (apple) with galls caused by *Erisoma lanigerum* (D, bottom). Photo credits: A, DPI 702698-4, J. Windsor; B, Clemson Ext. Serv.; C, DPI 700531; D, DPI 702702-15 & -11, J. Windsor.

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**BACTERIA:** At least one root gall forming bacterium is detrimental to its hosts. Agrobacterium tumefaciens (Smith & Townsend) Conn. causes galls on many woody plants such as pome fruits, stone fruits, pecans, roses, willows, raspberries, blackberries, and grapes (1). In many cases, galls occur at the crown of the plant, but in some plants such as roses and pecan, (Fig. 1B) galls frequently occur on the roots. In general, galls formed by A. tumefaciens are more convoluted and are often larger than galls formed by root-knot nematodes.

**FUNGI:** Among the fungi, the best known example of a detrimental root-gall forming organism is the slime mold, Plasmodiophora brassicae Woron., which is distributed throughout the world and causes clubroot of crucifers. Infected plants have spindle-like, spherical, and knobby or club-shaped swellings on roots or rootlets (Fig. 1C). These malformations may coalesce and cover the entire root system of the plant. Galled roots are more susceptible to the invasion of secondary bacteria which often cause root disintegration and the subsequent formation of toxic substances responsible for wilting of plants (1).

**VIRUSES:** The most studied galls or tumors produced by a virus are caused by the wound tumor virus on the roots of clovers such as crimson clover, Trifolium incarnatum L., and sweet clovers, Melilotus officinalis Lam. and M. alba Desr. In a systemically infected plant, galls develop close to the pericycle cells that are wounded when developing side roots break through the cortex. The galls have a somewhat roughened surface, and they tend to be more round in shape than detrimental galls caused by other organisms (2).

**INSECTS:** In contrast to the predominate role insects have as causal agents of foliar galls, they are less frequently associated with root-galls. It is estimated that only 5% of the organisms causing root galls are insects (3). Aphids, phylloxerans, beetles, wasps, and midges are the most common types of insects causing root galls (3). In Florida, two examples of insects that cause root-galls which are similar in appearance to those caused by nematodes are the phylloxeran, Daktulosphaira vitifoliae Fitch, on grape, Vitis sp., and the woolly aphid Eriosoma lanigerum Hausman, on apple, Malus sp. Severe galling may result from heavy infestation of the woolly apple aphid (Fig. 1D), and in some cases may result in the stunting or death of trees (4).

#### SURVEY AND DETECTION:

1. If possible, distinguish between beneficial and detrimental galls. Normally beneficial galls such as nodules caused by Rhizobium sp. contain a pink liquid and may normally be easily detached from the host roots. In contrast, the galls caused by nematodes and other pathogens are generally an integral part of the plant root and are difficult to remove without tearing adjacent root tissue.
2. If a detrimental organism is suspected as a causal agent, galled roots and soil should be submitted for laboratory analysis.

#### LITERATURE CITED:

1. Agrios, G. N. 1978. Plant pathology. Academic Press. New York, NY. 703 pp.
2. Black, L. M. 1970. Wound tumor virus. C.M.I./A.A.B. Description of Plant Viruses No. 34. 4 pp.
3. Mani, M. S. 1974. Ecology of plant galls. Dr. W. Junk Publishers, The Hague, Netherlands. 434 pp.
4. Metcalf, C. L., W. P. Flint and R. L. Metcalf. 1962. Destructive and useful insects, their hosts and control. McGraw-Hill, New York, NY. 981 pp.
5. Russo, R. A. 1979. Plant galls of the California region. Boxwood Press, Pacific Grove, CA. 203 pp.